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Study of PN population in nearby dwarf galaxy NGC 3077

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1 Introduction

Planetary nebulae (PNe) in nearby galaxies are drawing particular attention due to their role as metallicity indicators, which is important in order to investigate chemical composition and expand the understanding of the star formation history. Also, PNe can be used as a tracker of the internal kinematics of a galaxy. Last but not least, the PNe luminosity function is a well-known distance indicator. NGC3077 is an interesting nearby local dwarf galaxy in the M81 group, but no PNe have been mapped in this galaxy yet.

2 Observations

NGC 3077 was observed at the 2.5-m SAI MSU telescope [2] using the Mapper of Narrow Galaxy Lines (MaNGaL) developed in SAO RAS. MaNGAL is a tunable-filter imager based on the Fabry-Perot piezoelectric scanning interferometer with low interference order.Observations were carried out in the emission lines: [OIII] λ 5007, Hα, [NII] λ 6583 and [SII] λ 6717,6731. Improved astrometric accuracy was achieved by means of the shapelet technique for image processing (the shapelet decomposition [1]).

3 Selection of candidates for planetary nebulae

In the emission line images (Fig. 1), a system of ionized filaments is clearly visible, most noticeable in the $H\alpha$ line. At the same time, dozens of compact emission objects appear, which can be either planetary nebulae (PNe), supernova remnants (SNRs), emission-line stars or small HII regions etc.

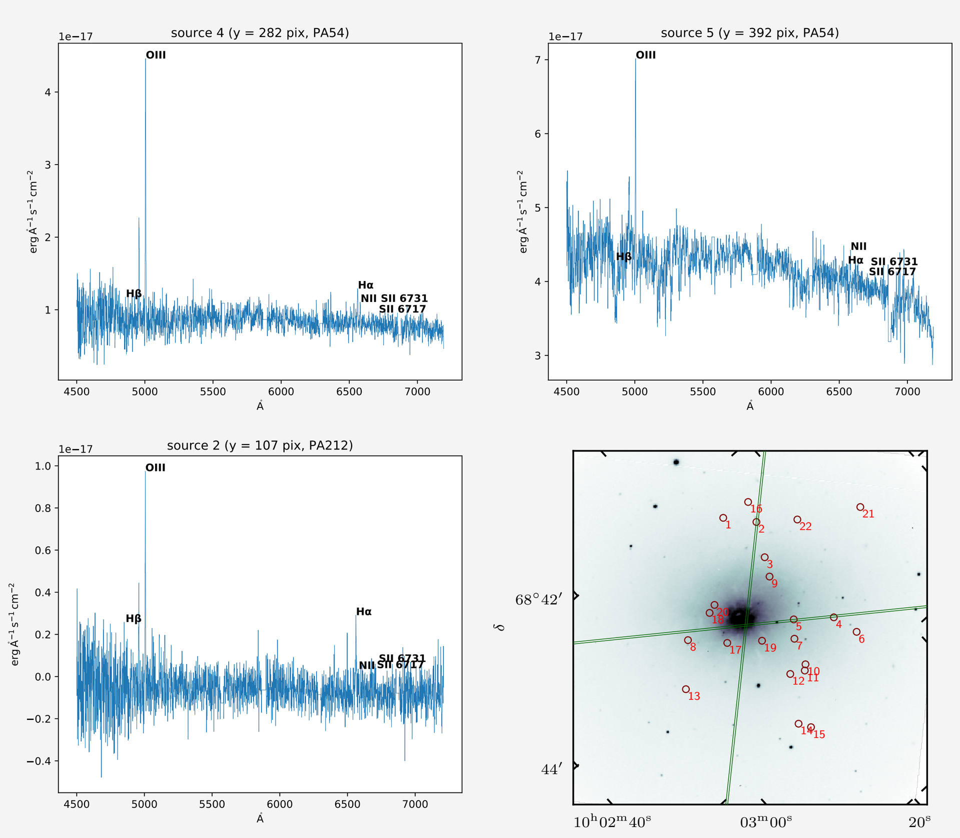

Figure 3: Spectra of sources: #4 and #5 (top), source #2 (below), image in the R filter with slit position (bottom right).

4 Object detection

Point sources in [OIII] images were detected by using `SExtractor`.

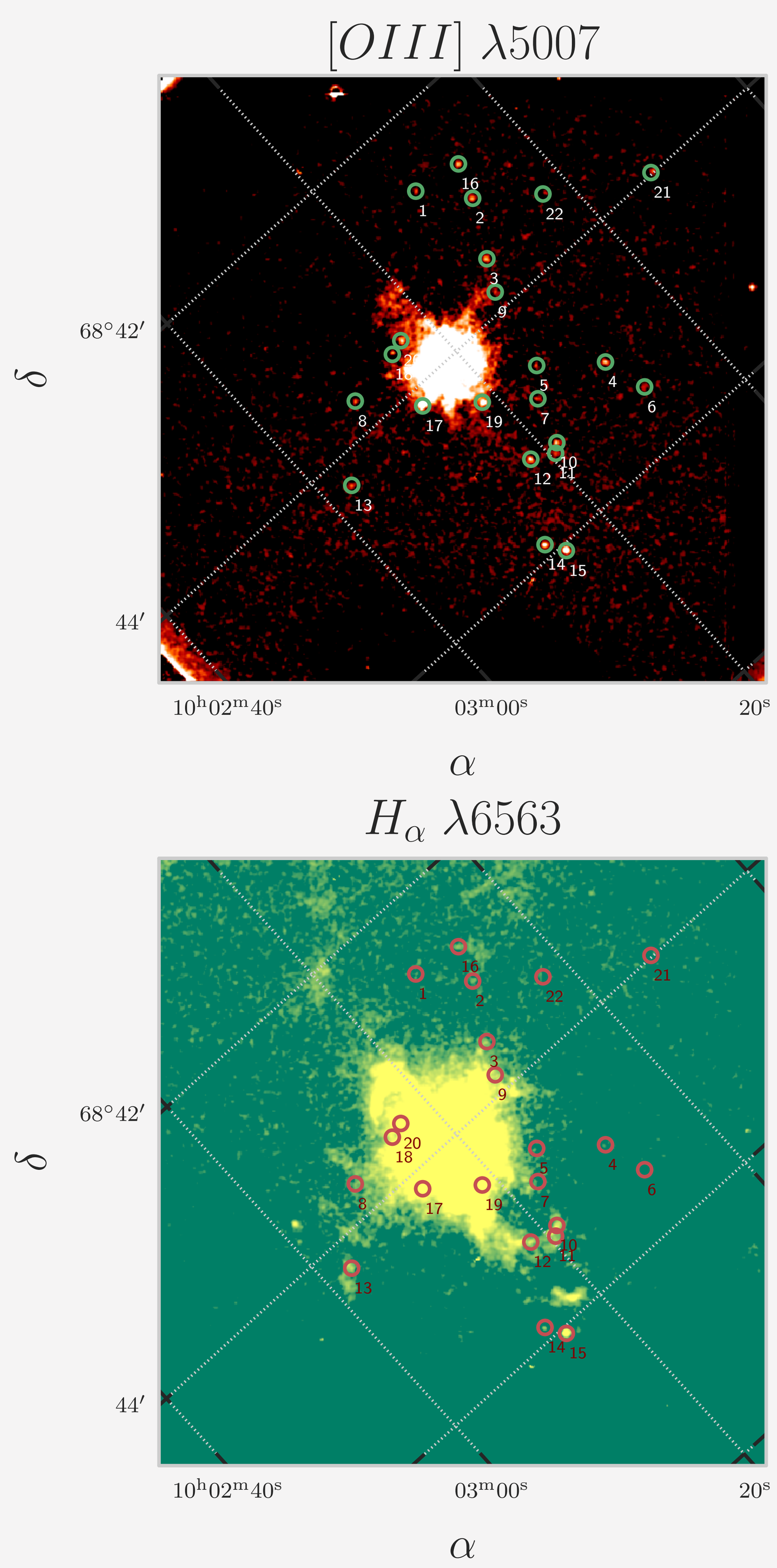

Figure 1: Location of the detected point sources on the maps of the galaxy NGC 3077 in the [OIII] λ 5007 and Hα emission lines.

There are 22 objects left in the sample after excluding false detected objects. In order to perform photometry of the sources identified on the continuum-subtracted [OIII] images the `Astropy` Package for Photometry `Photutils` was used. We used source apertures with diameters set to 5 pixels (which corresponds to ∼3.3 arcsec). The local background level was estimated as the mean value within an annulus of an inner radius of 10 pixels and an outer radius of 15 pixels. We derived dust extinctions from Balmer decrements and then corrected all emission line flux maps. The mean value of Balmer decrement was estimated from long-slit spectroscopic observations $(H\alpha/H\beta)_{observ} \approx 3.3$

5 Diagnostic diagrams

Analysis of the ionization state of the gas was performed through using a set of nebular emission line diagrams [4] used to distinguish the ionization mechanism of nebular gas (Fig. 2).

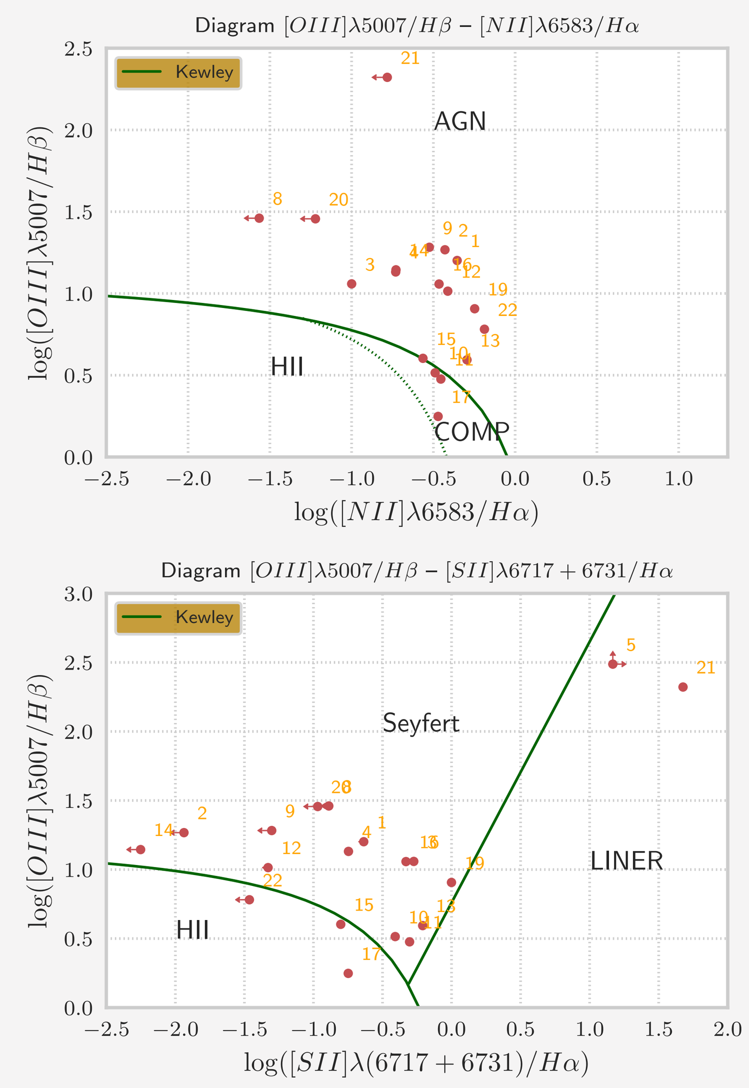

Figure 2: Line ratio diagnostic diagrams.

6 Spectral confirmation of candidates

Analysis of spectroscopic data obtained with the multi-mode focal reducer SCORPIO-2 [3] at the 6-meter telescope was performed. Spectroscopic observations were carried out in the spectral range of 3600 – 7070 ÅÅ at two position angles. They were considered in [6]. The obtained spectra of source #2 at a position angle of 212° and sources #4 and #5 at a position angle of 54° are presented in Fig. 3. The spectra of these sources correspond to the PNe emission.

7 Conclution

- Two sources (#13 and #19) were identified as optically emitting SNRs with a high [SII]/Hα ratio.
- Three sources (## 15,17 and 22) were identified as compact HII-regions.
- The rest 17 sources have been identified as PNe candidates with $\frac{I(\lambda 5007)}{I(H\alpha+[NII])} > 1.6$ (criterion of discriminating PNe from HII regions [5]).

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